

CHAPTER 5 – DRAINAGE AND STORM DRAIN STANDARDS

1. GENERAL

- A. All drainage design and requirements shall be in accordance with the latest City of Carlsbad Standard Urban Storm Water Mitigation Plan (SUSMP), Jurisdictional Urban Runoff Management Plan (JURMP), Master Drainage and Storm Water Quality Management Plan and the requirements of the City Engineer and be based on full development of upstream tributary basins.
- B. Public drainage facilities shall be designed to carry the ten-year six-hour storm underground and the 100-year six-hour storm between the top of curbs. All culverts shall be designed to accommodate a 100-year six-hour storm with a one foot freeboard at entry conditions such as inlets and head walls.
- C. The use of underground storm drain systems, in addition to standard curb and gutter shall be required:
 - 1) When flooding or street overflow during 100-year six-hour storm cannot be maintained between the top of curbs.
 - 2) When 100-year six-hour storm flow from future upstream development (as proposed in the existing General Plan) will cause damage to structures and improvements.
 - 3) When existing adequate drainage facilities are available for use (adjacent to proposed development).
 - 4) When more than one travel lane of arterial and collector streets would be obstructed by 10-year 6-hour storm water flow. Special consideration will be required for super-elevated streets.
- D. The use of underground storm drain systems may be required:
 - 1) When the water level in streets at the design storm is within 1" of top of curb.
 - 2) When velocity of water in streets exceeds 11 FPS.
 - 3) When the water travels on surface street improvements for more than 1,000'.
- E. The type of drainage facility shall be selected on the basis of physical and cultural adaptability to the proposed land use. Open channels may be considered in lieu of underground systems when the peak flow exceeds the capacity of a 48" diameter RCP. Fencing of open channels may be required as determined by the City Engineer.
- F. Permanent drainage facilities and right-of-way, including access, shall be provided from development to point of approved disposal.

- G. Storm Drains constructed at a depth of 15' or greater measured from finish grade to the top of pipe or structure shall be considered deep storm drains and should be avoided if at all possible. When required, special design consideration will be required to the satisfaction of the City Engineer. Factors considered in the design will include:

- 1) Oversized specially designed access holes/air shafts
- 2) Line encasements
- 3) Oversizing lines
- 4) Increased easement requirements for maintenance access
- 5) Water-tight joints
- 6) Additional thickness of storm drain

The project designer should meet with the planchecker prior to initiation of design to review design parameters.

- H. Concentrated drainage from lots or areas greater than 0.5 acres shall not be discharged to City streets unless specifically approved by the City Engineer.
- I. Diversion of drainage from natural or existing basins is discouraged.
- J. Drainage design shall comply with the City's Jurisdictional Urban Runoff Management Plan (JURMP) and requirements of the National Pollutant Discharge Elimination System (NPDES) permit.

2. HYDROLOGY

- A. Off site, use a copy of the latest edition City 400-scale topographic mapping. Show existing culverts, cross-gutters and drainage courses based on field review. Indicate the direction of flow; clearly delineate each drainage basin showing the area and discharge and the point of concentration.
- B. On site, use the grading plan. If grading is not proposed, then use a 100-scale plan or greater enlargement. Show all proposed and existing drainage facilities and drainage courses. Indicate the direction of flow. Clearly delineate each drainage basin showing the area and discharge and the point of concentration.
- C. Use the charts in the San Diego County Hydrology Manual for finding the " T_c " and " I ". For small areas, a five minute " T_c " may be utilized with prior approval of the City Engineer.
- D. Use the existing or ultimate development, whichever gives the highest " C " factor.
- E. Use the rational formula $Q = CIA$ for watersheds less than 0.5 square mile unless an alternate method is approved by the City Engineer. For watersheds in excess of 0.5 square mile, the method of analysis shall be approved by the City Engineer prior to submitting calculations.

3. HYDRAULICS

A. Street - provide:

- 1) Depth of gutter flow calculation.
- 2) Inlet calculations.
- 3) Show gutter flow Q, inlet Q, and bypass Q on a plan of the street.

B. Storm Drain Pipes and Open Channels - provide:

- 1) Hydraulic loss calculations for: entrance, friction, junction, access holes, bends, angles, reduction and enlargement.
- 2) Analyze existing conditions upstream and downstream from proposed system, to be determined by the City Engineer on a case-by-case basis.
- 3) Calculate critical depth and normal depth for open channel flow conditions.
- 4) Design for non-silting velocity of 2 FPS in a two-year frequency storm unless otherwise approved by the City Engineer.
- 5) All pipes and outlets shall show HGL, velocity and Q value(s) for design storm.
- 6) Confluence angles shall be maintained between 45° and 90° from the main upstream flow. Flows shall not oppose main line flows.

4. INLETS

A. Curb inlets at a sump condition should be designated for two CFS per lineal foot of opening when headwater may rise to the top of curb.

B. Curb inlets on a continuous grade should be designed based on the following equation:

$$Q = 0.7 L (a + y)^{3/2}$$

Where: y = depth of flow in approach gutter in feet
a = depth of depression of flow line at inlet in feet
L = length of clear opening in feet (maximum 30 feet)
Q = flow in CFS, use 100-year design storm minimum

C. Grated inlets should be avoided. When necessary, the design should be based on the Bureau of Public Roads Nomographs (now known as the Federal Highway Administration). All grated inlets shall be bicycle proof.

D. All catch basins shall have an access hole in the top unless access through the grate section satisfactory to the City Engineer is provided.

- E. Catch basins/curb inlets shall be located so as to eliminate, whenever possible, cross gutters. Catch basins/curb inlets shall not be located within 5' of any curb return or driveway.
- F. Minimum connector pipe for public drainage systems shall be 18".
- G. Flow through inlets may be used when pipe size is 24" or less and open channel flow characteristics exist.

5. STORM DRAINS

- A. Minimum pipe slope shall be .005 (.5%) unless otherwise approved by the City Engineer.
- B. Minimum storm drain, within public right-of-way, size shall be 18" diameter.
- C. Provide cleanouts at 300' maximum spacing, at angle points and at breaks in grade greater than 1%. For pipes 48" in diameter and larger, a maximum spacing of 500' may be used.

When the storm drain clean-out Type A dimension of "V" less "Z" is greater than 18", a storm drain clean-out Type B shall be used.

- D. The material for storm drains shall be reinforced concrete pipe designed in conformance with San Diego County Flood Control District's design criteria, as modified by Carlsbad Standard Specifications. Corrugated steel pipe shall not be used.

Plastic/rubber collars shall be prohibited.

- E. Horizontal curve design shall conform to manufacturer recommended specifications. Vertical curves require prior approval from the City Engineer.
- F. The pipe invert elevations, slope, pipe profile line and hydraulic grade line for design flows shall be delineated on the mylar of the improvement plans. Any utilities crossing the storm drain shall also be delineated.

The strength classification of any pipe shall be shown on the plans. Minimum D-load for RCP shall be 1350 in all City streets or future rights-of-way. Minimum D-load for depths less than 2', if allowed, shall be 2000 or greater.

- G. For all drainage designs not covered in these Standards, the current San Diego County Hydrology and Design and Procedure Manuals shall be used.
- H. For storm drain discharging into unprotected or natural channel, proper energy dissipation measures shall be installed to prevent damage to the channel or erosion. In cases of limited access or outlet velocities greater than 18 fps, a concrete energy dissipater per SDRS D-41 will be required.

- I. The use of detention basins to even out storm peaks and reduce piping is permitted with substantiating engineering calculation and proper maintenance agreements. Detention basins shall be fenced.
- J. Desiltation measures for silt caused by development shall be provided and cleaned regularly during the rainy season (October 1 to April 30) and after major rainfall as required by the City Engineer or his designated representative.

Adequate storage capacity as determined by the City Engineer shall be maintained at all times.
- K. Protection of downstream or adjacent properties from incremental flows (caused by change from an undeveloped to a developed site) shall be provided. Such flows shall not be concentrated and directed across unprotected adjacent properties unless an easement and storm drains or channels to contain flows are provided.
- L. Unprotected downstream channels shall have erosion and grade control structures installed to prevent degradation, erosion, alteration or downcutting of the channel banks.
- M. Storm drain pipes designed for flow meeting or exceeding 20 feet per second will require additional cover over invert reinforcing steel as approved by the City Engineer.
- N. Storm drain pipe under pressure flow for the design storm, i.e., HGL above the soffit of the pipe, shall meet the requirements of ASTM C76, C361, C443 for water-tight joints in the sections of pipe calculated to be under pressure and an additional safety length beyond the pressure flow point. Such safety length shall be determined to the satisfaction of the City Engineer taking into consideration such factors as pipe diameter, Q, and velocity.
- O. An all weather access road from a paved public right-of-way shall be constructed to all drainage and utility improvements. The following design parameters are required: Maximum grade 14%, 15 MPH speed, gated entry, minimum paved width 12 feet, 38' minimum radius, paving shall be a minimum of 4" AC over 4" Class II AB, turnaround required if over 300'. Work areas should be provided as approved by the plan checker. Access roads should be shown on the tentative project approval to ensure adequate environmental review.
- P. Engineers are encouraged to gravity drain all lots to the street without use of a yard drain system. On projects with new street improvements proposed, a curb outlet per SDRSD D-27 shall be provided for single-family residential lots to allow yard drains to connect to the streets gutter.